Effect of Executive Functions Training and Physical Activity on Working Memory, Inhibitory Control and Numerical Skills of Preschoolers

A

Synopsis

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Supervisor

Dr. Sona Ahuja

Associate Professor

Researcher

Shivani

Head of the Department

(Pedagogical Sciences)

Prof. Archna Kapoor

Dean (Faculty of Education)

Prof. K.C. Vashishtha

FACULTY OF EDUCATION

DAYALBAGH EDUCATIONAL INSTITUTE

DAYALBAGH, AGRA

1.0 Introduction

Children need to perform various tasks like paying attention, shifting from one action to another, keeping some information in mind, waiting for their turn and any more. All these require them to plan and execute the actions. In such complex and ever changing environment executive functions (EFs) play very important role. EFs enable an individual to plan for actions, to start accordingly and to stay on that task until its completion.

1.1 Executive Functions

Executive functions (EFs) are the cognitive abilities of an individual that are responsible for directing, controlling and coordinating other cognitive functions and behavior (Klenberg, 2015). These functions encompass a host of interrelated but somewhat independent processes involved in planning and carrying out regulated goal directed activity (Garon, Bryson & Smith, 2008; McCloslcey, Perkins & Diviner, 2008 as cited in Flook et al., 2010). EFs therefore serve as the key for self- regulated activities and play very important role in learning and functioning in school environment (Klenberg, 2015).

The concept of EFs was originated from researches on patient with frontal lobe damage during 1970's. The term executive function was first used by Pribram in 1973 while discussing about the prefrontal cortex function. It has emerged as an umbrella term used for diversity of hypothesized cognitive processes including planning, working memory, inhibition, attention, etc. carried out by pre-frontal areas of the frontal lobes (Goldstein et al., 2014).

Different psychologists have defined this term in different ways. And components of EFs vary across models. Lezak (1995) stated that EFs consist of volition; planning, purposeful actions and effective performance (see Otero & Barker, 2014 for a review). Baddeley (1996) hypothesized executive functions as unified system of phonological loop, visuospatial sketchpad and episodic buffer. Barkley (2011) put emphasis on the fact that EFs are comprised of the six basic elements including working memory, planning, problem solving, self-monitoring, interference control and self-motivation. Naglieri & Goldstein (2013) focused on nine areas as

components of EFs including attention, emotion regulation, flexibility, organization, planning, self- monitoring and working memory (see Otero & Barker, 2014 for a review).

In the developmental literature the model developed by Miyake et al. (2000) has been very influential and widely accepted (Anderson & Reidy, 2012; Klenberg, 2015). This includes three major components: Working memory, Inhibitory control and Cognitive flexibility. This model is most appealing to developmental psychologists because these components of executive functions are assessable from a very young age (Anderson & Reidy, 2012). Diamond (2013) also emphasized that EFs consist of a family of three interrelated core skills: inhibitory control, working memory and cognitive flexibility.

From these three components, higher order EFs are built such as reasoning, problem solving, and planning (Collins & Koechlin, 2012; Lunt et al., 2012 as cited in Diamond and Ling, 2015). According to Miyake's model executive functions contribute to performance on more complex tasks of planning, flexibility and strategy use (Klenberg, 2015). This three-component model describes working memory as the ability to hold information in mind and work with that information as a platform for guiding the behavior; inhibitory control as the suppression of pre-potent or affectively driven behaviors and cognitive flexibility as switching flexibly between tasks (Miyake et al., 2000).

1.2 Development of Executive Functions in Preschoolers

Earlier it was assumed that the cognitive processes underpinning executive functions emerged in early adolescence, when frontal lobes reached an adequate level of maturity (Golden, 1981). But it is known now that the signs of working memory, inhibitory control and cognitive flexibility can be seen even during infancy (Diamond, 1985).

Working memory and inhibitory control are the two core executive functions that develop rapidly during the preschool period, leading to significant improvement in children's ability to control and regulate their behavior (Garon et al., 2008 as cited in Blakey & Carol, 2015). These undergo rapid development during early childhood from about 2 to 6 years of age (Zelazo, Blair

& Willoughby, 2016). The executive attention shows major period of development during early years of life (Rueda et al., 2005). Thus the preschool period is the most appropriate time when EFs of children can be developed at its maximum.

1.3 Role of Executive Functions in Children's Life

EF skills play very important role in children's emerging academic abilities, above and beyond levels of general intelligence (Blair & Razza, 2007 as cited in Flook, et al., 2010). These skills contribute significantly to both mathematical and literacy achievement (Bull & Scerif, 2001; Blair & Razza, 2007; Clark et al., 2010 as cited in Flook, et al., 2010). It is also central to school readiness and early school achievement (Blair & Raver 2015). Children with greater executive attention efficiency show higher level of competence at school, social and emotional adjustment in the classroom (Blair & Razza, 2007; Bull & Scerif, 2001; Checa et al., 2008 as cited in Zelazo, Blair & Willoughby, 2016).

EFs also play an important role in self-control of behavior and emotional self-regulation (Blair & Diamond, 2008; Checa, Bailón, & Rueda, 2008; Eisenberg, Valiente, & Eggum, 2010; Riggs et al., 2006; Rueda, Checa, & Rothbart, 2010 as cited in Zorza1, Marino & Mesas, 2016). The development of EFs is significantly related to children's learning (Bull et al., 2008). They control and regulate basic abilities such as attention, memory etc. so that behavior can flexibly adapt to different situations (Zorza, Marino & Mesas, 2016).

Poor EFs are associated with cognitive deficits and poor academic functioning (Blair, 2002). The functioning of neural system is interconnected in a way that improvement in one area adds to the benefits to other areas of functioning including cognitive, behavioral and emotional (Klingberg, Forssberg & Westerberg, 2002). On the contrary, deficits in one area of functioning may disrupt functioning in other areas of functioning (Flook et al., 2010).

Disruptions in these functions are associated with several childhood onset behavioural disorders including ADHD, Autism Spectrum Disorder and behavioural problems such as delinquency (Brocki & Bohlin, 2006; Hughes, White, Sharpen & Dunn, 2000). And higher level of these

attentional and effortful control processes helps in the prevention of developing behavioral problems and ADHD (Eisenberg et al., 2005).

1.4 Executive Functions and Numerical Skills in Preschoolers

The processing of numerical information is a dominant feature of everyday life whether it is shopping for groceries, counting the objects, calculating the time etc. We constantly use numerical information to guide our behavior and make decisions. While there has been much more attention placed on literacy and its importance for life success, there is clear evidence to suggest that basic numerical and mathematical skills play a critical role in determining an individual's life success. Early numeracy skills are associated with achievement in school mathematics (Purpura & Napoli, 2015; Starkey, Klein & Wakeley, 2004 as cited in Reid, 2016).

Before children start school, there is substantial growth in preschooler's numeracy skills. Numerical skills or number sense can be defined as the flexible use of numbers to compare, recognise patterns and solve problems (Gersten & Chard, 1999). Such skills are thought to develop before formal instruction (Dehaene, 1997 as cited in Whyte & Bull, 2008) and these skills are strong predictors of arithmetic and mathematics skills when children enter in school (Booth & Siegler, 2006). Preschool children exhibit verbal skills, such as counting (Mix, 2010).

But there are some children who are unable to perform even simple arithmetic tasks and have difficulty in even understanding the basic concepts of numbers like- addition, subtraction or multiplication when they enter in school. A review of neuropsychological research in math skills reveals that many low achievers in mathematics exhibit deficits in executive functions. Working memory being one of the major components of executive functions plays a very important role in mathematics learning as Raghubar, Barnes and Hecht (2010) reported that while solving mathematical problem, working memory is required to hold partial information, process new information, and ignore irrelevant information.

During the preschool period executive function skills play important role in supporting mathematical skills (Bull et al., 2008; Clark et al., 2010). Given the importance of numerical

skills in children's life, it is important to develop them as early as possible. The association of numerical skills with executive functions reflects that training to executive functions can be a great way to develop numerical skills of preschoolers.

1.5 Executive Functions Training and Preschoolers

The relationship between early EFs and later school achievement is fairly robust (Traverso et al., 2015). Executive functions, being so important in each and every aspect of children's life needs to be developed as early as possible. Thus preschool period is the most appropriate time when EFs of the children should be developed. Various authors in recent years have also suggested the importance of early interventions (Bryck & Fisher, 2012; Blakey & Carroll, 2015; Heckman, 2006).

Executive functions can be trained using different techniques but the most appropriate way to train them can be the direct training to EFs. This cognitive training include training on computerized tasks of attention, problem solving, working memory and training on non-computerized tasks of a EFs. Several studies have also shown that EFs can be improved with training (Blair & Diamond, 2008; Diamond et al., 2007; Diamond & Lee, 2011; Rosário et al., 2007).The interventions being priori be more successful in younger children due to greater plasticity in neural networks (Wass, 2015), the preschool period is the most appropriate time when the executive functions training should be given to children so that they would not suffer from EF deficits in later life.

1.6 Physical Activity and Cognition

Human beings are born to be physically active and their bodies are designed to be moved (Anneke, 2015). Movement of body or being physically active is a central concept in the development of cognition (Llinas, 2001). Cognition is a general term that includes various mental processes including intelligence, attention, perception and executive functioning (Tomporowski, Davis, Miller, & Naglieri, 2008 as cited in Anneke, 2015).

Physical activity is defined as any bodily movement produced by skeletal muscles that require energy. Physical activity is found to be associated with cognition, attention and memory (Colcombe & Kramer, 2003). Regular exercise induces changes in brain regions critical to learning and memory as a result of increased cerebral blood flow (Etnier et al., 1997). Bouts of exercise stimulate flow of neurological changes in the hippocampus that have been linked to memory alliance (Kempermann, 2008).

Acute bouts of exercise result in an increase in the release of neurotransmitters responsible for synaptic transmission and plasticity in brain (Best, 2010). The executive function hypothesis states that the exercise helps in neural growth and amends synaptic transmission in ways that alter thinking, decision making and behavior in the brain regions tied to EFs (Kopp, 2012 as cited in Donnelly et al., 2016).

From the neuropsychological findings regarding physical activity and brain structure it is clear that physical activity bouts can be a great tool to enhance cognition in children and executive functions (working memory and inhibitory control) being one of the cognitive processes can be improved by physical activity exposure.

Given the importance of executive functions and numerical skills in children's life it is important to find out the appropriate methods of developing them so that they can meet the demands of the later life.

2.0 Emergence of the Problem

There are children who get off poor start at school and are unable to perform as good as their peers when they enter into school. Lack of attention, inability to hold information in mind and inability to focus on appropriate stimulus may be some of the reasons for this. These problems if exists for longer time may lead to deficits in executive functions.

Executive Functions are the cognitive processes responsible for goal- directed behavior and include working memory (ability to hold information in mind for short period), inhibitory control (ability to focus on appropriate stimuli), and cognitive flexibility (ability to adapt to

changing situations and demands) (Miyake et al., 2000). Deficits in executive functions can take form of severe behavioral disorders including ADHD, Autism Spectrum Disorder (Sharpen & Dunn, 2000). These disorders and inabilities to perform well at tasks may affect negatively their cognitive, social and emotional development in later life.

Children who experience deficits in working memory tend to experience difficulties in school related learning and subjects including mathematics (Alloway, Gathercole, Kirkwood & Elliot, 2009). To overcome the problem of EF deficits and academic decline in later life children should be trained for EFs at very early age when the plasticity of neural network reaches at its peak (Wass, 2015). How can these skills of preschoolers be improved? Can these skills be improved either by cognitive or physical training at the very young age of 2-4 years? To what extent this training is transferable to numerical skills of preschoolers or it has no transfer effect on numerical skills? Such questions motivated the researcher to conduct the present study.

3.0 Justification of the Problem

In last decades EFs have become major focus in field of education, psychology and neuroscience. The reason behind this is the important role executive functions play in every aspect of individual's life. Previous researchers have found that EFs determine successful transition to kindergarten (Blair & Razza, 2007) and school readiness (Blair and Raven, 2015; McClelland et al., 2007).

EFs in preschool children determine later academic outcome (Blair & Razza, 2007; Bull, Espy & Wiebe, 2008; Clark, Pritchard & Woodward, 2010 as cited in Rohiteslberger, 2012). Working memory and inhibitory control are the two core executive functions that develop rapidly during the preschool period, leading to significant improvement in children's ability to control and regulate their behavior (Garon et al., 2008 as cited in Blakey and Carol, 2015). Working memory and inhibition have been shown to be related to a range of abilities such as theory of mind (Perner & Lang, 1999) and academic achievement (Biederman et al., 2004; Gathercole, Brown & Pickering, 2003 as cited in Thorell et al., 2009). They are also found to be associated

with neurodevelopmental disorders such as Attention Deficit Hyperactivity Disorder (Wilcutt, Doyle, Nigg, Faraone & Pennington, 2005).

During the preschool period these skills play an important role in supporting school readiness and mathematical skills (Bull et al., 2008; Clark et al., 2010). The relationship between early EFs and later school achievement is fairly robust (Traverso et al., 2015). Thus it is important that EFs (working memory and inhibitory control) of the children should be developed at early age. However very little of this research has focused on preschool years when EFs undergo significant improvement (Wass et al., 2012). Most of the studies have targeted school- age children (Jaeggi et al., 2008; Rode et al., 2014; Henry et al., 2014; Karbach et al., 2014 as cited in Blakey & Carroll, 2015) and focused specially on working memory training.

In the beginning the researches in the area of executive functions training mainly focused on training of EFs to atypically developed children (Klinberg, Forssberg & Westerberg, 2002; Klingberg et al., 2005). These studies have found positive results as after training there was lack in ADHD symptoms. Later researchers started targeting cognitive training of EFs to normally developed children, but most have focused on children in the age range 8-12 years (Jaeggi et al., 2008; Holmes, Gathercole, & Dunning, 2009; Rode et al., 2014; Karbach et al., 2014). These studies also found positive results of EF training.

Although the results of EF interventions are promising yet very few have targeted preschoolers (Blakey & Carrol, 2015; Thorell et al., 2009). Thus the considerable amount of research in this area is needed when EFs of the children undergo significant improvement (Wass et al., 2012). Little of the research that have targeted preschoolers have shown the contradictory views regarding the training effect on inhibitory control, the one of the most fundamental component of executive functions. Thorell et al. (2009) investigated the effect of working memory and inhibitory control training on preschoolers age range 4-5 years. He found positive effect on working memory but no effect on inhibitory control. Rueda et al. (2005) also did not find any effect of cognitive training on inhibitory control. On the contrary Dias and Seabra (2015) found

increased inhibitory control after the executive functions training. Thus the renewed focus on EF interventions is needed to examine its effect on inhibitory control.

Diamond and Ling (2015) did the meta- analysis of 84 studies and found that one question remained unanswered is that do interventions have immediate effect or the effects last for longer time? This question also needs to be answered to fulfill the existing research gap. The next issue that needs to be addressed is examining the effect of executive functions training on numerical skills of preschoolers. This is of importance, since much of the utility of EFs training rests on its effectiveness in improving real life situations (Blakey & Caroll, 2015). EFs are being found with increased mathematical achievement (Das et al., 2014). Thus training to EFs can be a great way to improve numerical skills of preschoolers. Few studies have aimed at addressing this issue. Some found no transfer effect on mathematical skills (Henry et al., 2014; Karbach et al., 2014). And some did find transfer effect on mathematical skills (Goldin et al., 2014; Blakey & Carroll, 2015). Thus the issue needs to be readdressed.

Researchers not only targeted cognitive training to EFs but in recent years the focus of the researchers are moving towards physical activity to identify its effect on cognition. Various researches have been done in this direction. Castelli et al. (2007) examined the relation between aspects aerobic fitness and found the positive results. Pontifex et al. (2012) also found that the children with greater aerobic fitness were more accurate on executive functioning tasks compared to their lower fit peers.

Although the benefits of physical activity are promising yet researcher did not come across any research examining the effect of physical activity on young children's EFs. Diamond (2015) did the meta- analysis of studies related to physical activity and executive functions and stated that no one has looked at the possible EF benefits of simple aerobic exercise or resistance training in young children (3-6 years of age). No study has examined the combined effect of physical training and activities that demands EFs although it can be the better way to improve EFs of young children (Diamond, 2015). Thus it becomes important to see whether physical activity

exposure prior to EFs training to young children will benefit working memory and inhibitory control, the two core EFs.

In the light of fulfilling the existing research gaps, the present study is aimed at addressing the following questions. First, what effect will EFs training have on working memory and inhibitory control of the preschoolers as opposed to merely improving performance on the trained task? Second, what if EFs training is provided to children exposed to physical activity? Will this have greater effect on working memory and inhibitory control or same as EFs training? Third, whether the effect of EFs training will last for longer time period? Or it is immediate and short term. The one more question the study will aim at answering is whether the effect of training on working memory and inhibitory control is transferable to numerical skills of preschoolers?

The researcher did not come across studies that may give satisfactory answer to the above questions therefore the present study will be conducted to find out the equitable answers to these questions.

4.0 Statement of the Problem

Effect of Executive Functions Training and Physical Activity on Working Memory, Inhibitory Control and Numerical Skills of Preschoolers

5.0 Operational Definition of the Constructs

For the present study, constructs are defined on the basis of functional definition as underlined below.

Executive Functions

Executive functions are the set of high level cognitive skills including working memory (ability to hold information active in mind and to mentally work with that information as a platform for guiding our behavior), inhibitory control (ability to suppress pre-potent or affectively driven behaviors) and cognitive flexibility (ability to switching flexibly between tasks or mental sets) that underpin goal directed behavior (Miyake et al., 2000).

Working memory

Gathercole and Alloway (2004) defined working memory as the ability to hold and manipulate information in mind for a short period of time. It provides a flexible mental workspace that is used in many important activities in everyday life.

Inhibitory Control

Blakey and Carroll (2015) defined inhibitory control as the ability to suppress distracting information or task inappropriate behaviour.

Executive Functions Training

In the present study EFs training is training to preschoolers on the well-known tasks of working memory, inhibitory control and cognitive flexibility (details in subsequent section).

Physical Activity

Physical activity is any bodily movement produced by skeletal muscles that require energy expenditure (Donnelly, 2016). In the present study physical activity is implied to activities like-walking, running, jumping, stretching of hands and legs etc. by the young children.

Numerical Skills

Numerical skills can be defined as the flexible use of numbers to compare, recognize patterns and solve problems (Gersten & Chard, 1999).

6.0 Variables of the Study

The variables of the study are:

Independent Variables

Executive Functions Training and Physical Activity

Dependent Variables

Working memory, Inhibitory Control and Numerical Skills

7.0 Objectives of the Study

- To study the effect of executive functions training on working memory of preschoolers.
- To study the effect of executive functions training on inhibitory control of preschoolers.
- To study the transfer effect of executive functions training on numerical skills of preschoolers.
- To study the effect of executive functions training along with physical activity on working memory of preschoolers.
- To study the effect of executive functions training along with physical activity on inhibitory control of preschoolers.
- To study the effect of executive functions training along with physical activity on numerical skills of preschoolers.
- To compare the effect of executive functions training and executive functions training along with physical activity on working memory, inhibitory control and numerical skills of preschoolers.

8.0 Hypothesis of the study

- There will be no significant effect of executive functions training on working memory of preschoolers.
- There will be no significant effect of executive functions training on inhibitory control of preschoolers.
- There will be no significant transfer effect of executive functions training on numerical skills of preschoolers.
- There will be no significant effect of executive functions training along with physical activity on working memory of preschoolers.
- There will be no significant effect of executive functions training along with physical activity on inhibitory control of preschoolers.

- There will be no significant transfer effect of executive functions training along with physical activity on numerical skills of preschoolers.
- There will be no significant difference between the effect of executive functions training and executive functions training along with physical activity on working memory, inhibitory control and numerical skills of preschoolers.

9.0 Delimitations of the Study

The study will be delimited to the preschoolers of Dayalbagh, Agra in the age range 2-4 years.

10.0 Research Design and Methodology

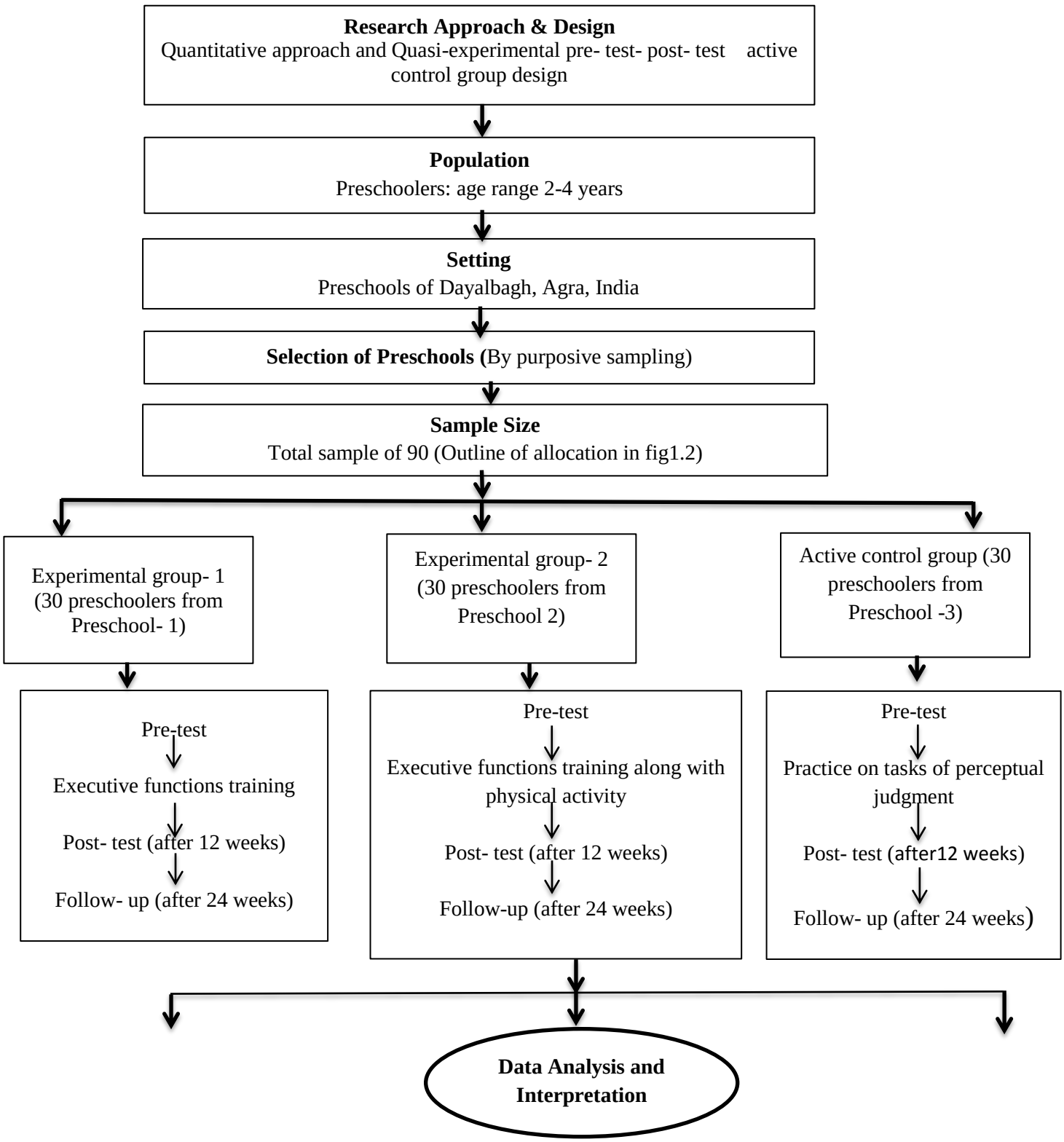
Research Approach & Design
Quantitative approach and Quasi-experimental pre- test- post- test active control group design
Population
Preschoolers: age range 2-4 years
Setting
Preschools of Dayalbagh, Agra, India
Selection of Preschools (By purposive sampling)
Sample Size
Total sample of 90 (Outline of allocation in fig1.2)
Experimental group- 1 (30 preschoolers from Preschool- 1)
Experimental group- 2 (30 preschoolers from Preschool 2)
Active control group (30 preschoolers from Preschool -3)
Pre-test
Executive functions training
Post- test (after 12 weeks)
Follow- up (after 24 weeks)
Pre-test
Executive functions training along with physical activity
Post- test (after 12 weeks)
Follow-up (after 24 weeks)
Pre-test
Practice on tasks of perceptual judgment
Post- test (after12 weeks)
Follow- up (after 24 weeks)
Data Analysis and Interpretation

Figure 1 Research Design and Methodology

10.1 Sampling Procedure

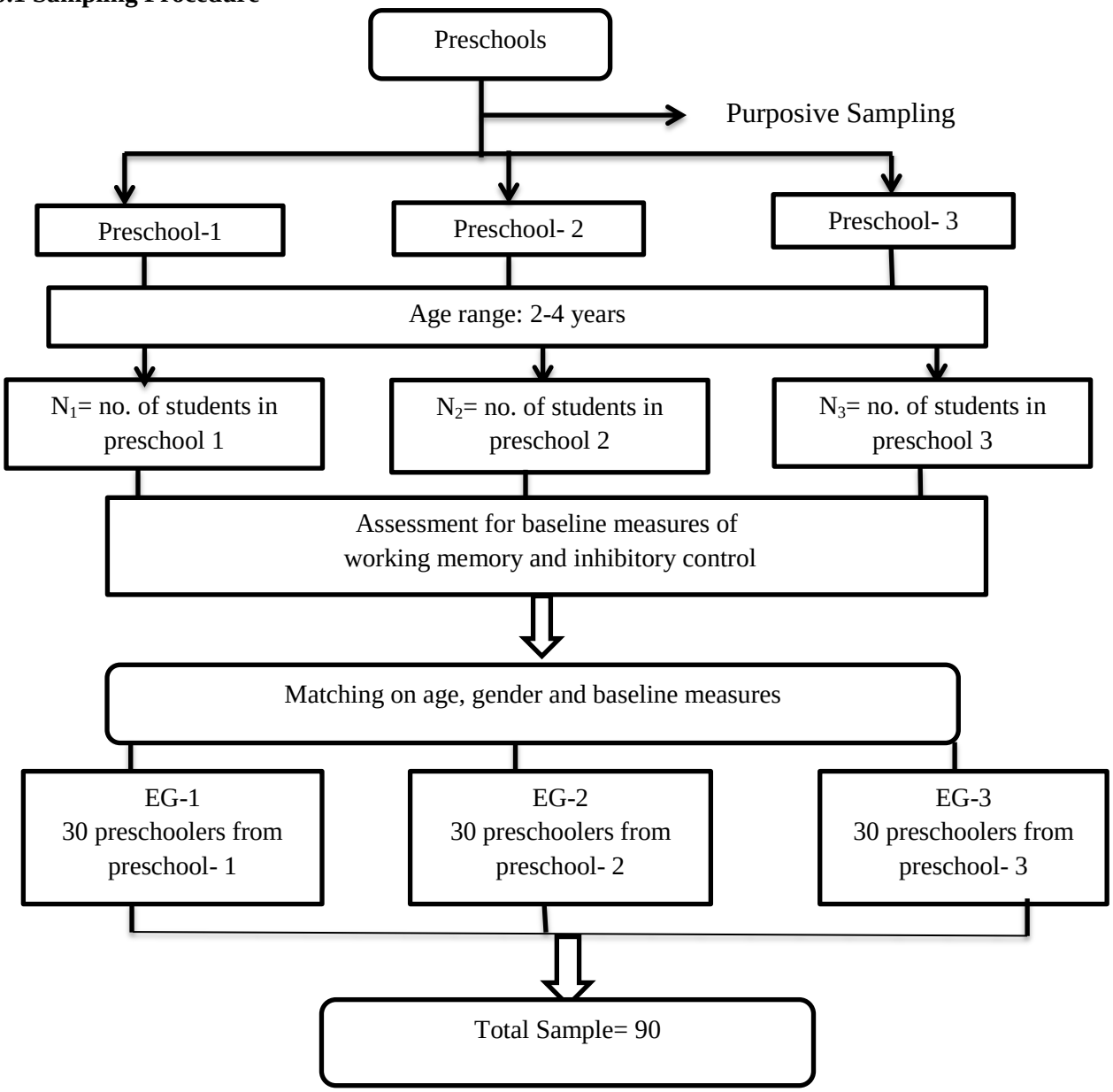
Preschools
Purposive Sampling
Preschool-1
Preschool- 2
Preschool- 3
Age range: 2-4 years
N1= no. of students in preschool 1
N2= no. of students in preschool 2
N3= no. of students in preschool 3
Assessment for baseline measures of working memory and inhibitory control
Matching on age, gender and baseline measures
EG-1 30 preschoolers from preschool- 1
EG-2 30 preschoolers from preschool- 2
EG-3 30 preschoolers from preschool- 3
Total Sample= 90

Figure 2 Sampling Procedure

11.0 Procedure of the Study

Children in 3 preschools of Agra within the age range 2-4 years whose parents will provide written consent for participation in study will be assessed for baseline measures of working memory and inhibitory control. The equal number of children from preschool 1, preschool 2 and preschool 3 will be allocated to experimental group 1, experimental group 2 and experimental group 3 respectively after matching on age, gender and baseline measures of working memory and inhibitory control. The children of experimental group 1 will be exposed to executive

functions training. The children of experimental group 2 will be exposed to physical activity during early morning along with executive functions training. The children of experimental group 3 will practice active control tasks.

Participants of experimental group 1 will be trained in group and then individually for EF tasks. The training on EF tasks will be of 30 minutes a day (20 minutes in group and 10 individually) for 6 days in a week for total 3 months. The participants of group 2 will be exposed to 2 hours of physical activity during early morning prior to EFs training for same period of time as experimental group 1. The active control group will practice the tasks that require simple perception for the same time period of time as experimental group 1 and 2.

After three months of training all the three groups will be assessed for working memory, inhibitory control and numerical skills to examine the effectiveness of interventions. Groups will also be assessed 3 months after the training at follow- up in order to examine whether the training effects last for longer time or they are immediate. The details of the intervention programme are given in succeeding section.

11.1 Executive Functions Training Intervention

In executive functions training preschoolers will be trained for tasks of executive functions. The details of the tasks used for training is given in table 1 and 2. Executive functions training will be given in two phases first in group and then individually (a mixed approach suggested by Röthlisberger et.al, 2012).

S.No.	Task	Underlying Cognitive Process	Short Description
1.	Simon Says (Strommen, 1973)	Inhibition of pre-potent Behavior	Perform the commanded action only if experimenter says "Simon says".
2.	Luria's hand Game (Diamond and Taylor, 1996)	Inhibition of pre-potent Behavior	Make the hand gesture opposite to the experimenter's hand gesture.
3.	Fruit and vegetable game (Rothlisberger et al., 2012)	Flexibility use	Different fruit/vegetable names are assigned to children, the child corresponding to vegetable name have to change his/her seats when name of that fruit/vegetable is called. All children have to change their seats when 'fruit salad' is called.
4.	Cotton wool game (Rothlisberger et al., 2012)	Storing and retrieving of Information	Pass the cotton wool to the child whose name is whispered in your ears.
5.	Pattern movement game (Rothlisberger et al., 2012)	Storing and retrieving of Information	Show movement according to the pattern drawn on cards shown before.

Table 1 *Group Training Tasks*

S.No.	Task	Underlying Cognitive Process	Short Description
1.	Six Box Task (Diamond, et.al, 1997)	Storing and retrieving of Information	Find the reward hidden in boxes shown before.
2.	Word Series	Storing and retrieving of Information	Recall the words in the same order as told.
3.	Get ready and Go (adopted version of GO/ NO-GO task	Inhibition of pre-potent behavior	Show flying gesture when picture of flying bird is shown only on red card.
4.	Colour card game (adopted version of Stroop task)	Inhibition of pre-potent Behavior	Read the name of the colour on cards independent of colour of written word.
5.	Dimensional card sorting (Carlson, 2005)	Flexibility use	Sort card according to dimension (colour, shapes etc.)

Table 2 *Individualized Training Tasks*

11.2 Physical Activity Intervention

The experimental group 2 will be exposed to physical activity prior to EFs training. The children of this group will visit open fields with their parents during early morning for 2 hours and will indulge in basic physical activities like running, walking, jumping, stretching of hands and legs etc.

11.3 Active Control Group Intervention

The control group will complete three tasks that require children to make simple perceptual judgements. The first task will require children to decide whether objects are the same or different; the second task will require children to search for a particular image among group of pictures (for example: find the fruit in the tree etc.) and the third task will require children to find out which set of pictures has more objects. The control group tasks will last for the same duration as the training tasks of the experimental group.

12.0 Assessment Tasks / Baseline Measures

The following assessment tasks will be used in order to assess the working memory and inhibitory control of preschoolers.

To assess training effects, three tasks will be administered at different time points: 1 week before training (baseline), 1 week after training (post-training), 3 months after training (follow-up). The tasks that will be used for assessment do not share the same surface features or instructions as the training tasks. The tasks that will be used for assessment are as follows:

Working memory task

Backward Word Span (Davis and Pratt, 1996) is a measure of working memory capacity. In this task children will be shown pictures of familiar objects one at a time (e.g., a ball and bat) and will be asked to recall them in a backward order. Children will complete two practice trials and then up to nine experimental trials, three of each span length (two, three and four). If children

will get at least two out of the three trials correct, the span length will be increased. The dependent variable will be the number of trials correctly recalled in a backward order.

Inhibitory Control Task

Peg-tapping task (Diamond and Taylor, 1996) is the measurement of children's inhibitory control. In this children will be asked to tap twice with a stick when the experimenter tap once; and to tap once when the experimenter tap twice. After watching a demonstration from the experimenter, children will complete twelve trials in a fixed order (six of each rule, with no more than three consecutive trials of one rule). The dependent variable will be the correct number of responses.

Numerical Skills Task

Self - constructed tasks will be used to assess the numerical skills of preschoolers.

13.0 Statistical Techniques

The following statistical techniques will be used to analyze the collected data.

Descriptive Statistics

Mean and Standard Deviation

Inferential Statistics

Analysis of Co- Variance (ANCOVA) will be used to determine the effect of intervention on working memory, inhibitory control and numerical skills of preschoolers.

14.0 Significance of the Study

Executive Functions (EFs) being the significant key for goal directed behavior plays an important role in one's life. They are found to be associated with academic achievement (Blair & Diamond, 2008), mental health (Diamond & Lee, 2011), and success throughout life (Moffitt et al., 2011). As executive functions are very important for goal directed behavior, it becomes important for the teachers and parents that they should aim at developing executive functions of

children at a very early stage. If parents and teachers would not be concerned about improving EF's of the child at early stage then he/ she may not be able to give his/ her best in future. The present study will help in exploring the ways in which two core EFs working memory and inhibitory control can be improved. The study will also be helpful in knowing whether the training to executive functions can be one of the ways to improve numerical skills of the preschoolers.

The proposed study will be an attempt to examine the effectiveness of proposed executive functions training programme and physical activity. It will also help in assessing whether any difference exists between development of EFs of children trained only on EF tasks and children trained on EF tasks along with physical activity exposure. The study will also help in fulfilling the existing research gap in the area of executive functions, physical activity and preschoolers. It will bring awareness to parents, teachers, educationist and administrators regarding the role executive functions play in preschooler's life. It will also help them to identify the ways in which they can avoid the chances of executive function deficits that may occur in future lives of children if not properly channelized.

EFs training and EFs training along with physical activity may be a great tool to improve the executive functions of the young children without any expense. Thus it is importance to know whether executive functions training and executive functions training along with physical activity will have significant effect on executive functions of children or not? If yes then which between these two would give better results? And which one should teachers and parents use to improve the executive functions of the preschoolers?

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